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Experimental study of Soil Stabilization by adding Cement, Rice Husk Ash and Bagasse Ash

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***Abstract* - With increment in demand of land for industrialization, residential purposes and infrastructure development, soil stabilization is the best option to improve the engineering properties of soil according to the requirement of the infrastructure to be constructed.**

This project work presents the viability of agricultural waste i.e., Rice Husk Ash (RHA), Bagasse Ash and Cement as an added substance in further developing the geotechnical engineering properties of black cotton soil or expansive soil. The proportion of cement (4-6 %), Rice Husk Ash (8-10 %) and Bagasse ash (10-14 %) were used as soil stabilizer in this project to enhance the engineering properties of expansive soil also known as black cotton soil.

In this project study the proportion of Cement, Rice husk ash and Bagasse ash were used to increase the stability of expansive soil or black cotton soil.

The outcome of the experiments conducted during the research shows that after adding the proportions of Cement, Rice hush ash and Bagasse ash as stabilizer, increment in the unconfined compressive strength of the soil as compared to unconfined compressive strength of only black cotton soil. It also shows the increment in optimum moisture content after adding the stabilizer.

This shows the capability of utilizing agricultural waste i.e., Rice husk ash (RHA), Bagasse ash as admixture in cement stabilized black cotton soil.

Key Words*: *Black Cotton Soil (BCS), Rice Husk Ash (RHA), Sugar Cane Bagasse Ash (SCBA), Uniformity Coefficient (Cu), Curvature Coefficient (Cc), Optimum Moisture Content (OMC), Maximum Dry Density (MDD), Unconfined Compressive Strength (UCS).

1.INTRODUCTION

Stabilization of soil is nearly as normal a method as improvement of geotechnical engineering properties of soil itself [1], [2]. This basically alludes to blending of an unfamiliar component in development material for the improvement of the designing properties and at the equivalent time improving the economy of the infrastructure project [3].
With increment in the population, pollution also increases [4]. As population increases, land demand increases. In this scenario, soil stabilization is the best method to enhance the soil properties and the construct the infrastructure as required [5].
In present time engineers were already using cement as stabilizer to improve the properties of soil [6]. After some researches it is found that some agricultural waste has property of binding the particles as similar to cement or lime and it can be used as the alternative of cement or lime [7], [8]. Those agricultural waste are Rice Husk Ash (RHA), Bagasse Ash (from sugarcane) etc. [9], [10]

In India, practically 20% of the all-out region is covered by expansive soil, presently because of fast industrialization and gigantic populace development of our country, there is a shortage of land, to meet the human necessities [11]. And furthermore, the expense of restoration and retrofitting of the structural designing designs established over these soils are expanding step by step [12], [13]. Then again, the protected removal of rice husk ash (RHA) and bagasse debris from farming field has been a difficult issue in present day days and these waste effects on climate hazard and it influence the strength of human [14], [15]. Nonetheless, creation of concrete requires lime-stone and with the rate with which we are using concrete, the day isn't up until this point when the lime stone mines will get portrayed, and this involves reality that for each 1 kg of concrete assembling, 1 kg of carbon dioxide is delivered into the climate, which thus expands the carbon impression and furthermore have genuine danger to a dangerous atmospheric deviation [16], [17].
In this way there is a need to figure out elective binder, which is climate amicable as well as depended like cements [18], [19].

2. MATERIALS AND METHODOLOGY

2.1 MATERIALS USED IN STABILIZATION

i. Black Cotton Soil
ii. Cement
iii. Bagasse Ash
iv. Rice Husk Ash

2.2 METHODOLOGY

1) Soil samples were prepared by addition of different proportion (4%, 6%) of cement, (10%, 14%) of bagasse ash and (8%, 10%) of Rice Husk ash mixed with Black Cotton soil [11].
2) Different experiments were performed on above prepared soil samples to obtain geotechnical engineering properties [12].
3) The acquired experimental outcomes are contrasted with one another to see at what extent and with what material the expansive soil is more steady and less steady [20].
4) Our project is mainly on comparing the Atterberg constant limit, Optimum moisture content, Maximum dry density and Unconfined compressive strength of varied percentages cement, bagasse ash and rice husk ash mixed with black cotton soil [1].

5) After comparing the results best proportion is obtained.

LIST OF EXPERIMENTS PERFORMED

1) Particle Size Analysis
2) Liquid Limit Test
3) Plastic Limit Test
4) Standard Proctor Test
5) Unconfined Compressive Strength

Fig -1: Casagrande apparatus for liquid limit test

Fig -2: Compaction Rammer and Mould

Fig -3: Unconfined Compressive Strength Apparatus

Fig -4: Failure of sample of soil and soil with stabilizer due to unconfined compressive strength

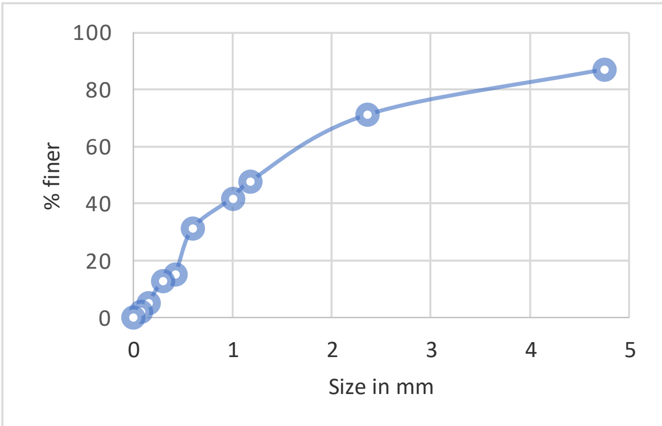
3. RESULT AND DISCUSSION

Results of Liquid limit, Plastic limit, Plasticity, MDD, OMC, and UCS are summed up in separate table. Examination of these outcomes has been done under the heading of ends.

3.1 RESULT OF SIEVE ANALYSIS

S.no	Sieve Size	Soil Retained (grams)	% Retained	Cumulative Retained (%)	% Finer
1	4.75 mm	64	12.8	12.8	87.2
2	2.36 mm	80	16	28.8	71.2
3	1.18 mm	117	23.4	52.2	47.8
4	1 mm	30	6	58.2	41.8
5	600 microns	53	10.6	68.8	31.2
6	425 microns	80	16	84.8	15.2
7	300 microns	12	2.4	87.2	12.8
8	150 microns	39	7.8	95	5
9	75 microns	15	3	98	2
10	PAN	10	2	100	0

Table -1: Experimental data of sieve analysis



Graph -1: Graph of Sieve Analysis of Black Cotton Soil

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D10 = 0.24mm, D30 = 0.65mm, D60 = 1.7mm
Uniformity Coefficient (Cu) = 7.08
Coefficient of curvature (Cc) = 1.04

3.2 RESULT OF LIQUID LIMIT AND PLASTIC LIMIT

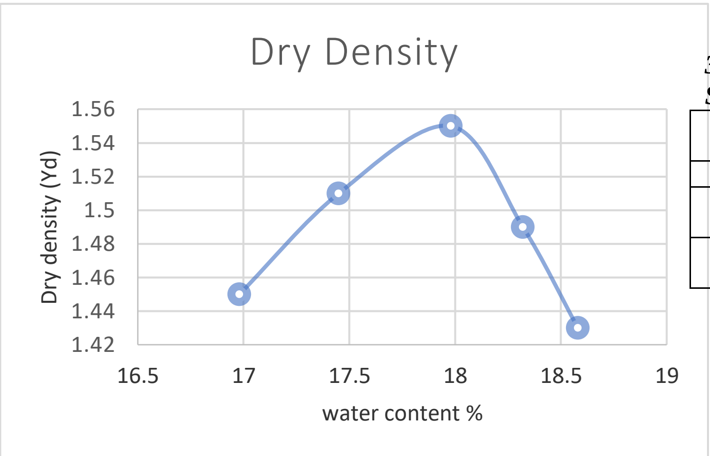
Specimen	Liquid Limit (%)	Plastic Limit (%)	Plasticity Index (%)
Black Cotton Soil	58	20.77	37.23
Soil + 4% cement + 10% bagasse ash + 8% RHA	48	19.35	28.65
Soil + 6% cement + 14% bagasse ash + 10% RHA	42	18.61	23.39

Table -2: Experimental Data of liquid and plastic limit

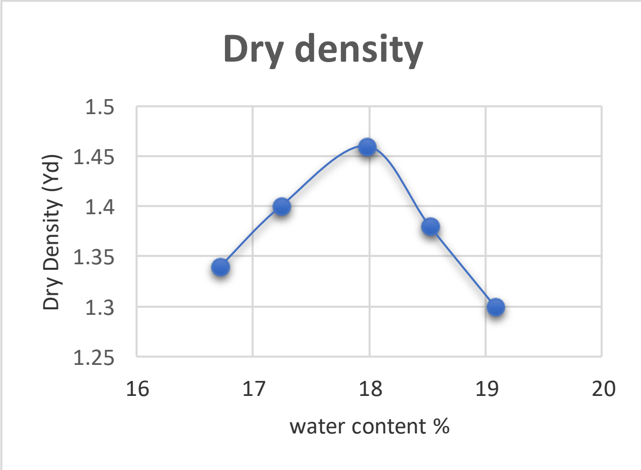
3.3 RESULT OF OMC AND MDD

Specimen	Optimum Moisture Content (%)	Maximum Dry Density (g/cm^3)
Black Cotton Soil	17.90	1.55
Soil + 4% cement + 10% bagasse ash + 8% RHA	17.98	1.46
Soil + 6% cement + 14% bagasse ash + 10% RHA	18.63	1.41

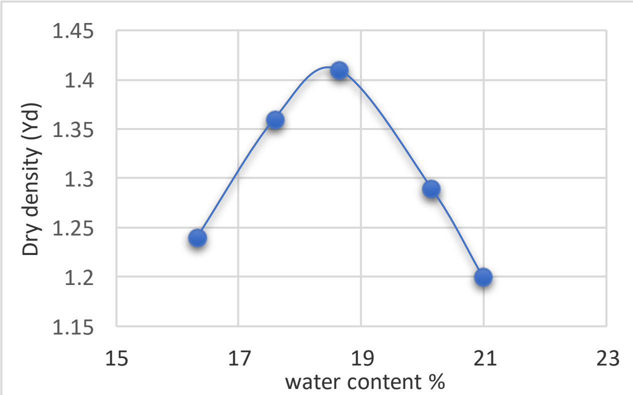
Table -3: Experimental Data of OMC and MDD



Graph -2: Graph of dry density and water content of Black cotton soil



Graph -3: Graph of dry density and water content of black cotton soil with stabilizer (4% cement + 10% bagasse ash +8%RHA)



Graph -4: Graph of dry density and water content of black cotton soil with stabilizer (6% cement + 14% bagasse ash +10%RHA)

3.4 RESULT OF UNCONFINED COMPRESSIVE STRENGTH TEST

Specimen	Unconfined Compressive Strength Kg/cm^2
Black Cotton Soil	1.06
Soil + 4% cement + 10% bagasse ash + 8% RHA	1.19
Soil + 6% cement + 14% bagasse ash + 10% RHA	1.27

Table -4: Experimental Data of Unconfined Compressive Strength test

4. CONCLUSION

1) Cc<3, therefore black cotton soil is classified as well graded sand.
2) Liquid Limit of soil is constantly decreases with increasing in the proportion of stabilizer (Cement, RHA & Bagasse Ash).
3) Plastic Limit of soil is constantly decreases with increasing in the proportion of stabilizer (Cement, RHA & Bagasse Ash).
4) Plasticity Index of soil is constantly decreases with increasing in the proportion of stabilizer (Cement, RHA & Bagasse Ash).

5) OMC of soil is constantly increases with increasing in the proportion of stabilizer (Cement, RHA & Bagasse Ash).
6) MDD of soil is constantly decreases with increasing in the proportion of stabilizer (Cement, RHA & Bagasse Ash).
7) Unconfined Compressive Strength of soil is constantly increases with increasing in the proportion of stabilizer (Cement, RHA & Bagasse Ash).
8) At proportion 6%- cement, 14%-Bagasse Ash & 10%-RHA, maximum compressive strength was obtained; that's why this is the optimum proportion of the suitable stabilizer.

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